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AUTHOR Slark, Julie; And Others
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ABSTRACT

In an effort to determine the validity of placement tests used at Rancho Santiago College (Santa Ana, California), for placing students into mathematics courses, a study was conducted comparing the course performance of students who met test cut-off scores ("eligible" to take the course) with students who did not meet the cut-off scores ("ineligible"). Students were tested using the California State University/University of California Mathematics Diagnostic Testing Project tests, and comparisons were made of the course success rates for eligible and ineligible students in Elementary Algebra (Math 50), Elementary Algebra Review (Math 60), and Intermediate Algebra (Math 80) in fall 1990 and spring 1991. Successful students were defined as those receiving grades of A, B, or C, or receiving course credit. Study results were as follows: (1) of the 454 students in Math 50, 83% scored above the placement test cut-off score, and 47% were successful in the course; (2) of the students in Math 50, 48% of those scoring above the cut-off scores were successful as compared with 41% of those scoring below the cut-off scores; (3) of the 266 students in Math 60, 94% scored above the cut-off and 61% were successful in the course; (4) of the students in Math 60, 62% of those scoring above the cut-off scores were successful in the course, compared with 47% of those scoring below the cut-off scores; (5) of the students in Math 80, 63% scored above the cut-off score and 63% were also successful in the course; (6) of the students in Math 80, 65% of those scoring above the placement test cut-off scores were successful in the course as compared with 58% of those scoring below the cut-off scores; and (7) correlations of placement test scores with course outcomes revealed the test cut-off scores were appropriate and should not be modified. Detailed data tables are included. (PAA)

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RANCHO SANTIAGO COLLEGE

RESEARCH · PLANNING
RESOURCE DEVELOPMENT

Report

RSC Validation of Mathematics Placement Tests

December 1991

Department of Institutional Research
Addendum by Julie Slark, Director
Research, Planning, and Resource Development

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Rancho Santiago College

Validation of Mathematics Placement Tests

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Rancho Santiago College
Validation of Mathematics Placement Tests

Design

Students who had been placed as a result of an assessment test score in Elementary Algebra (Math 050), Elementary Algebra Review (060), and Intermediate Algebra (Math 080) were the subjects of this predictive validity study. Students were tested using the CSU/UC Mathematics Diagnostic Testing Project (MDTP) battery of tests. For purposes of this study, Test #1 refers to the MDTP Algebra Readiness test; Test #2 refers to the MDTP Elementary Algebra test; and Test #3 refers to the MDTP Intermediate Algebra test. In keeping with compliance with the State of California, these basic skills classes (which are non-transferrable) were targeted for study in order to demonstrate that students who score above a determined cut-off score perform more successfully in class than students who score below the cut-off score.

The study was a post-hoc analysis of students' grades in the classes mentioned above for Fall 1990 and Spring 1991. In order for students to be admitted into the study, they had to meet the following criteria:

- Students had to have taken the math placement test on or after July 1, 1990, and
- No intervening coursework was completed between the placement testing and enrolling in Math 050, 060, or 080.

Students are considered successful if they received a grade of A,B,C, or Cr in the course. Students were deemed unsuccessful if they received a grade lower than a C or withdrew. Similarly, for the purposes of this study, "eligible" refers to students who met the cut-off criteria and "ineligible" defines those who did not meet that criteria.

Once students were categorized as successful or unsuccessful, eligible and ineligible, and their test scores entered into the computer system, a two by two analysis using a crosstabs procedure was evoked in order to evaluate the findings.

Further, in order to understand the correlation between the students' course outcome and placement test score, Pearson correlations were also computed. However, because of the limited

range which letter grades provide, it was felt that percentage scores were a better indicator of performance than was the letter grade for the correlation analysis. Students' total points in the class were converted, with the assistance of the instructors, to percentages so that we could control for the number of points possible in a course and also the number of tests. So if a person earned a total of 500 points out of a possible 800 in the course, they received a class performance score of 62.5%. This is the value that was correlated with their placement test score.

Subjects

After selecting students based on the above criteria, the final sample consisted of 51% men and 49% women. The ethnic distribution was as follows:

Table 1
Ethnic Distribution of Sample

Ethnicity	Frequency
White	39%
Hispanic	36%
Asian	15%
Black	5%
Filipino	1%
American Indian	1%
Pacific Islander	1%
Middle Eastern	1%
Other	1%

Test Materials

Students entering Math 050 are currently required to score at least 21 points on the Math Placement Test #1 in order to be admitted into that course. Similarly, students entering Math 060 have to have 12 points or greater on Math Placement Test #2 to be allowed entrance into that course. Students entering Math 080 must score 26 points or more on Math Placement Test

#2. Because of the small group of students who took Math Placement Test #3, this study is focussing only on the validity of Math Placement Tests #1 and #2 as they pertain to these courses.

Results

Math 050

It can be seen from Table 2 that of the 454 students in Math 050 in this study, 17% had scored below the cut score and 83% had scored above the cut score. Further, 47% of those 454 students were successful in the course, and 53% were not.

The success rate for students who scored above the cut score on the placement test was 48%, and for those who scored below the cut score the success rate was seven percentage points less, 41%.

The Pearson Correlation between the score on the Math Placement Test #1 and the performance score in the class was .33, $p < .05$.

Given these two measures, it can be concluded that there is a positive relationship between the placement test score and course performance; students who score above the cut score are more often successful in the course.

Table 2
Comparison of Successful vs. Non-Successful
Students Based on Test Performance

Math 050	Not Eligible	Eligible	ROW TOTAL
Successful	41%	48%	n=212 47%
Not Successful	59%	52%	n=242 53%
COLUMN TOTAL	n=78 17%	n=376 83%	n=454

In order to evaluate the appropriateness of the current cut-off scores for Math 050, the sample was evaluated by hypothetically selecting out students who met different selection criteria

Table 3
Comparison of Student Performance Across Possible Cut Scores

MATH 050 (n=454)	Score on RSC Math Placement Test #2						
	18	19	20	21	22	23	24
Not Eligible & Successful	4% n=20	6% n=25	6% n=29	7% n=32	9% n=42	11% n=48	12% n=34
Eligible & Successful	42% n=192	41% n=187	40% n=183	40% n=180	37% n=170	36% n=164	35% n=158
Not eligible & not successful	5% n=24	7% n=31	9% n=41	10% n=46	15% n=69	20% n=89	24% n=106
Eligible & not successful	48% n=218	47% n=211	44% n=201	43% n=196	38% n=173	34% n=153	30% n=136

(different placement test scores). For example, in Table 3 it can be seen that using the current cut-off score of 21 tends to provide for an optimal number of students who are both eligible to take the course and who are, in fact, successful (40%). Inspection of the table suggests that if we were to increase the cut scores, we would be eliminating too many students who are, in fact, successful or, by decreasing the cut-score, allowing too many students into classes who are in greater risk of failing.

Results

Math 060

Table 4 shows that 266 students were studied for Math 060, and 6% scored below the current cut-score and 94% scored above. Sixty-one percent (a higher success rate than for Math 050) were successful in the course, and 39% were not. Those who were eligible for the course according to their placement test score had a success rate fifteen percentage points higher than that for ineligible students, 62% versus 47%.

Table 4
Comparison of Successful vs. Non-Successful
Students Based on Test Performance

Math 060	Not Eligible	Eligible	ROW TOTAL
Successful	47%	62%	n=163 61%
Not Successful	53%	38%	n=103 39%
COLUMN TOTAL	n=15 6%	n=251 94%	n=266

These findings are commensurate with those of Math 050, inasmuch as students who are placed into the course by an appropriate placement test score are succeeding at a higher rate than students who score below the current cut-off scores on the test and are allowed into the course. The Pearson Correlation between the Math Placement Test #2 and course performance score for Math 060 was .14, $p < .05$.

From Table 5 it can also be seen that hypothetically moving the cut-off score for the second Math Placement Test would jeopardize student entry into the program. For example, the current Placement Test #2 requirement is that a student score 12 or greater in order to be eligible for Math 060. However, if we artificially increased that cut-off score, we would be eliminating a number of students who would otherwise have been very successful. By the same token, if we lower the cut-off even one point, we would be allowing people into the course who would be at higher risk of failing. The results suggest that at this time there is no justification for changing the cut-off scores in this course.

Table 5
Comparison of Student Performance Across Possible Cut Scores

MATH 060 (n=228)	Score on RSC Math Placement Test #2						
	9	10	11	12	13	14	15
Not Eligible & Successful	0% n=1	0% n=1	2% n=5	3% n=7	6% n=17	9% n=25	13% n=34
Eligible & Successful	61% n=162	61% n=162	59% n=158	59% n=156	55% n=146	52% n=138	49% n=129
Not Eligible & Not Successful	1% n=2	1% n=2	1% n=3	3% n=8	7% n=19	9% n=24	12% n=33
Eligible & Not Successful	38% n=101	38% n=101	38% n=100	36% n=95	32% n=84	30% n=79	26% n=70

Results

Math 080

When evaluating the results from Math 080 using Placement Test #2, we find that 37% of the students in the course were ineligible according to their placement test score versus 63% who were eligible; 63% were successful and 37% were not. The success rate for eligible students was 65% and for ineligible students it was 58%.

Table 6
Student Performance with Current Cut Score

	Not Eligible	Eligible	ROW TOTAL
Successful	58%	65%	n=170 63%
Not Successful	42%	35%	n=101 37%
COLUMN TOTAL	n=101 37%	n=170 63%	n=271

This finding is consistent with the findings of other course samples, which points to the fact that students who were placed by the current cut-off criteria succeed at a higher rate.

The Pearson Correlation between performance in the course and the test score #2 was .21, $p < .05$.

As with the other courses, we artificially selected students at different cut scores for Math 080, and from Table 7 we can see that the same type of decision would be made. We would eliminate too many students who would otherwise have been successful, and, at the same time if we lowered the test score cut-off at all, several students would be admitted who would fail.

Table 7
Comparison of Student Performance Across Possible Cut Scores

MATH 080 (n=169)	Score on RSC Math Placement Test #2						
	23	24	25	26	27	28	29
Not Eligible & Successful	15% n=40	17% n=46	20% n=53	22% n=59	24% n=64	27% n=74	31% n=85
Eligible & Successful	48% n=130	46% n=124	43% n=117	41% n=111	39% n=106	35% n=96	31% n=85
Not Eligible & Not Successful	13% n=34	14% n=38	15% n=41	16% n=42	19% n=50	20% n=55	24% n=64
Eligible & Not Successful	25% n=67	23% n=63	22% n=60	22% n=59	19% n=51	17% n=46	14% n=37

Discussion of Findings

The results of this evaluation show that the predictive validity of the Math Placement Test does, indeed, exist. There are increases in success rates in the three courses examined with respect to students who were eligible by test score to those who were not.

It should be noted that one of the limitations of using this design is that students were already placed into the course with a placement rule. Therefore, we do not have a representative sample of the full range of students' test scores or the students' course performance for those who scored below the cut-offs. Therefore, the success rate for the total number of students in the courses is quite high. For example, in Math 060, 61% of students are successful and in Math 080 63% are successful.

If we were to test a random sample of students and then allow them to enter into Math 050, we would expect that the majority of students who were eligible for the course would succeed at a much higher rate than those who were not eligible because the range of test scores in the course would be greater.

The success rate for those who were ineligible for these courses are probably inflated because many could have been allowed into the class for other seemingly justifiable reasons. For example, counselors who advise students and note from their past experience that they have

been quite successful, or can determine that a student's motivation is quite high, may have let a student into a course based on those criteria even though they did not score above the cut-score required for a course. The success rates of the ineligible students in this study indicate that their placement was not always inappropriate, however.

Another limitation of the current study is that anywhere from 12-21% of the students who take Math 050, 060, and 080 do not have test scores; they were admitted into the course because they had completed a prerequisite course. Therefore, if we were able to test the entire sample of students in the Math Department, we might find that the results would be a little more robust.

Yet another variable affecting the findings of this type of a study is the fact that students who received "W" grades were included in the sample studied. While it is true that some students withdraw because they do not have appropriate skills (those would be in the ineligible group), some withdraw for reasons other than those related to their preparatory skills. That is, it is possible that some of those categorized as unsuccessful by virtue of receiving a "W" grade could have been successful in the course had not the need to withdraw, for reasons other than lack of skills, presented itself.

Suggestions for Future Research

Obviously, the best method for obtaining a predictor of validity is to conduct an experiment whereby a random sample of students is evaluated with a placement test all on the same day, and then are allowed to take any of the courses under question. Their performance can then be tracked during the semester and a much clearer evaluation of the impact of the test score can be shown. Given the fact that this type of research design creates an inordinate amount of administrative and classroom problems, below are some other suggestions offered for future study. From results of studies that we have done at Rancho Santiago College using reading test scores and student success in courses, the following recommendations are offered:

- A student's progress during the course should be monitored and correlated at distinct intervals of time. For example, during the semester the correlation between students' performance on major exams should be evaluated with their test score. In this way, several data points during the semester can be entered into

a multiple regression equation so that we have many more measures of the student's ability as opposed to just using their final course grade.

- All students could be tested on the first or second day of class in order to eliminate all the variables that come into the testing setting over a period of time.
- More stringent controls over the actual recording of the scores need to be put into place in order to avoid some of the problems that were encountered in the course of this study.
- Data related to instructor perception of student preparedness could be gathered early in the semester and compared with test scores.

Addendum

Addendum

The richness of the data base created by the authors of this study has tempted this writer to conduct additional analyses beyond that initially planned and described in the foregoing. Further, it is the intention of RSC matriculation program managers to continually analyze the appropriateness of RSC's assessment mechanisms and to continually add to the work of test validation. The analyses of this report are also intended to be used as examples for validation studies for other RSC courses and departments.

Below are additional analyses conducted using the same data base as that used in the report under this cover.

Math 050

Performance in Math 050	Eligible n=376	Not Eligible n=78
>90%	13%	1%
81-90%	16%	3%
71-80%	12%	5%
61-70%	5%	4%
41-60%	5%	7%
<41%	5%	3%
none (W's, etc)	44%	77%
TOTAL	100%	100%

Course	Average Math Placement Test Score		
	Successful	Non-Successful	
Math 050 (Test #1)	27.67	25.11	p=.00

Course	Average Final Course Grade	
	Eligible	Not Eligible
Math 050	3.27	3.37

Math 060

Performance in Math 060	Eligible n=251	Not Eligible n=15
>90%	17%	7%
81-90%	23%	7%
71-80%	17%	26%
61-70%	11%	13%
41-60%	6%	7%
<41%	4%	0%
none (W's, etc.)	22%	40%
TOTAL	100%	100%

Course	Average Math Placement Test Score		
	Successful	Non-Successful	
Math 060 (Test #2)	19.49	17.14	p=.00

Course	Average Final Course Grade	
	Eligible	Not Eligible
Math 060	2.81	3.33

Math 080

Performance in Math 080	Eligible n=170	Not Eligible n=101
>90%	22%	8%
81-90%	17%	8%
71-80%	13%	7%
61-70%	5%	4%
41-60%	4%	1%
<41%	1%	0%
none (W's, etc.)	38%	72%
TOTAL	100%	100%

Course	Average Math Placement Test Score		
	Successful	Non-Successful	
Math 080 (Test #2)	28.78	25.55	p=.00

Course	Average Final Course Grade	
	Eligible	Not Eligible
Math 080	3.15	3.04

Conclusions

- For each of the three courses studied, the average placement test score of successful students was significantly higher than that for non-successful students, indicating a positive relationship between course success and placement test score.
- For each of the three courses studied, the percentage of students with W grades was higher for those students who were not eligible, by test score, for the course.

- For each of the three courses studied, the percentage of students with a course performance score over 80% was much greater for students who had entered the course with a placement test score at or above the existing cut-score.
- The average final course grade for eligible and ineligible students does not distinguish between the two groups.
- **These findings confirm those of the report: Students who score above the current placement test cut-scores for the three courses studied have a significantly higher probability of successfully completing the course. However, because the sample was limited by a placement rule already in effect, because some students in the courses who scored below the cut-score had been allowed into the course by a counselor according to other placement criteria, and because of the many students in the sample who received a "W" grade somewhat confound the findings, the success and performance score rates of those in this study who scored below the placement test cut-score were not terribly low.**

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